[0085] The apparatus **1000** may further comprise a memory **1004** connected to the processor **1002**. However, memory may also be integrated to the processor **1002** and, thus, the memory **1004** may not be required. The apparatus **1000** may further comprise a transceiver (TRX) **1006**. The TRX **1006** may further be connected to one or more antennas **100B** enabling connection to and from an air interface.

[0086] The processor **1002** may control the identification information of the at least one node. The processor **1002** may determine at least one node-specific probability as explained with reference to FIG. **7**. The processor **1002** may adjust the properties of at least one channel in the set of channels dedicated for informing node properties in a device-to-device communication network.

[0087] The eNB may transmit information to the nodes via the TRX **1006**. The information may be at least one of the following: the number of channels N_1 in the set of channels, the number of occasions N_2 in the set of occasions, a period T_0 between adjacent scheduled occasions, a period Ti between adjacent occasions in the set of occasions, and the policy for selecting the node-specific channel and occasion for broadcasting. The apparatus **1000**, such as the eNB, may be configured to perform functionalities related to FIGS. **1**, **3** and **7**. Further, the apparatus **1000** may co-operate with at least one neighboring eNB when performing the above described functionalities.

[0088] As used in this application, the term 'circuitry' refers to all of the following: (a) hardware-only circuit implementations, such as implementations in only analog and/or digital circuitry, and (b) to combinations of circuits and software (and/or firmware), such as (as applicable): (i) a combination of processor(s) or (ii) portions of processor(s)/software including digital signal processor(s), software, and memory(ies) that work together to cause an apparatus to perform various functions, and (c) to circuits, such as a microprocessor(s) or a portion of a microprocessor(s), that require software or firmware for operation, even if the software or firmware is not physically present.

[0089] This definition of 'circuitry' applies to all uses of this term in this application. As a further example, as used in this application, the term "circuitry" would also cover an implementation of merely a processor (or multiple processors) or portion of a processor and its (or their) accompanying software and/or firmware. The term "circuitry" would also cover, for example and if applicable to the particular element, a baseband integrated circuit or applications processor integrated circuit for a mobile phone or a similar integrated circuit in server, a cellular network device, or other network device.

[0090] FIG. **9** shows a method for efficient broadcasting in D2D network. The method starts in step **900**, In step **902**, a node capable of entering a device-to-device communication network selects a channel for broadcasting from a set of channels dedicated for informing node existence in the device-to-device communication network, wherein the selection is based on at least one of the following: the characteristics of the node and the state of the node. Advantageously, but not necessarily, in step **904**, the node selects an occasion for applying the selected channel for broadcasting from a set of occasions on the basis of at least one of the following: the characteristics of the node and the state of the node. In step **906**, the node causes a broadcast of information related to at least part of the properties of the node on the selected channel (at the selected occasion). The method ends in step **908**.

[0091] FIG. **11** shows a method for part of the operations performed by an eNB controlling the D2D communications. The method starts in step **1100**, In step **1102**, the eNB adjusts the properties of at least one channel in the set of channels. The eNB may also assign profiles for the channels, define profiles for the network nodes, control identification information of the node, and assign probabilities to the nodes, as explained earlier. The method ends in step **1104**.

[0092] The embodiments of the invention offer many advantages. The embodiments provide an efficient beacon resolution for D2D operation taking into account possible configuration and control of cellular systems and anticipated requirements for the D2D such as enhancing efficiency for cellular systems in terms of resource utilization, network performance, service quality and cost.

[0093] A low probability of collisions for the execution of beacon access procedures is ensured either by employing a unique identifier in the beacon selection process or by associating the various beacon channels and occasions indexes with specific properties. Both approaches may be combined for controlling the selection from sets of channel and occasion indexes which convey identical or basically equivalent information of related nodes.

[0094] The techniques and methods described herein may be implemented by various means. For example, these techniques may be implemented in hardware (one or more devices), firmware (one or more devices), software (one or more modules), or combinations thereof. For a hardware implementation, an apparatus may be implemented within one or more application-specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), processors, controllers, micro-controllers, microprocessors, other electronic units designed to perform the functions described herein, or a combination thereof. For firmware or software, the implementation can be carried out through modules of at least one chip set (e.g., procedures, functions, and so on) that perform the functions described herein. The software codes may be stored in a memory unit and executed by processors. The memory unit may be implemented within the processor or externally to the processor. In the latter case it can be communicatively coupled to the processor via various means, as is known in the art. Additionally, the components of the systems described herein may be rearranged and/or complemented by additional components in order to facilitate the achieving of the various aspects, etc., described with regard thereto, and they are not limited to the precise configurations set forth in the given figures, as will be appreciated by one skilled in the art.

[0095] Thus, according to an embodiment, the apparatus for performing the tasks of FIGS. **1**, **3** to **7** and **9** comprises processing means for selecting a channel for broadcasting from a set of channels dedicated for informing node existence in the device-to-device communication network, wherein the selection is based on at least one of the following: the characteristics of the node and the state of the node, and processing means for causing a broadcast of information related to at least part of the properties of the node on the selected channel.

[0096] Further, according to an embodiment, the apparatus for performing the tasks of FIGS. **1**, **3** and **7** comprises processing means for adjusting properties of at least one channel in the set of channels dedicated for informing apparatus properties in the device-to-device communication network, wherein the properties of the at least one channel comprise at